WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced Subsidiary/Advanced

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312/01

BIOLOGY

MODULE BI2

A.M. THURSDAY, 8 January 2004

(1 hour 30 minutes)

For Examiner's Use Only

Total Marks	

Centre Number .....

Candidate's Name (in full) .....

Candidate's Examination Number .....

INSTRUCTIONS TO CANDIDATES

Write your centre number, name and candidate number in the spaces provided above.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

1. *(a)* Name the blood pigment that carries oxygen in mammals. [1]

.....

(b) Give **one** property of a specialised gas exchange surface. [1]

.....

(c) Name the cell organelle that provides the energy for active transport. [1]

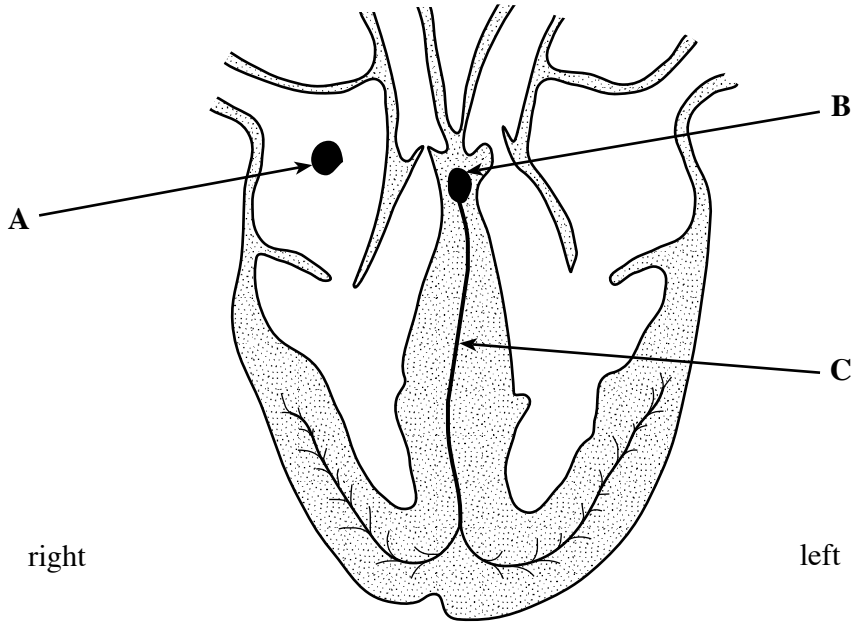
.....

(d) As the size of an organism increases which ratio decreases? [1]

.....

(Total 4 marks)

2. *(a)* Name the parts labelled **A, B** and **C,** in the diagram of the heart given below. [3]



A .....

B .....

C .....

(b) Briefly describe the function of **each** part. [3]

A .....

.....

B .....

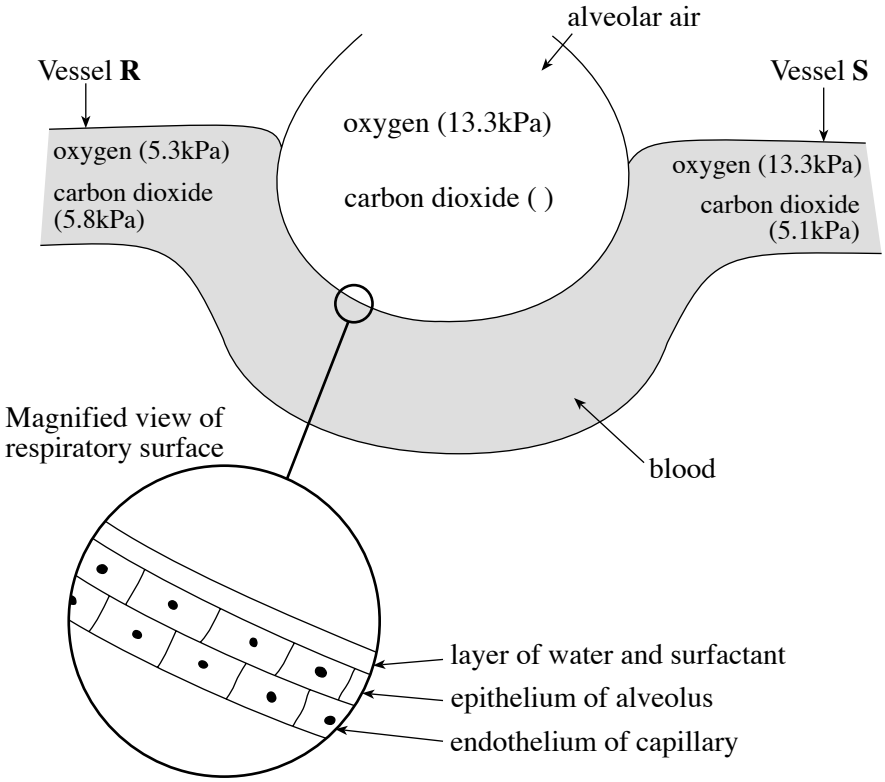
.....

C .....

.....

(Total 6 marks)

3. The diagram shows an alveolus and its blood supply. The numbers show the relative amounts of oxygen and carbon dioxide in various positions.



(a) (i) Name the process by which gases enter and leave the blood from the alveolus. [1]

.....

(ii) Suggest the value for the amount of carbon dioxide in the alveolus. [1]

.....

(iii) Which of the vessels **R** and **S** represents the arterial end of the capillary? [1]

.....

(iv) Give a reason for your choice [1]

.....

(b) Why do the amounts of oxygen and carbon dioxide remain relatively constant in the alveolus? [1]

.....

.....

(c) (i) What is the function of the surfactant found in the alveolus? [1]

.....

.....

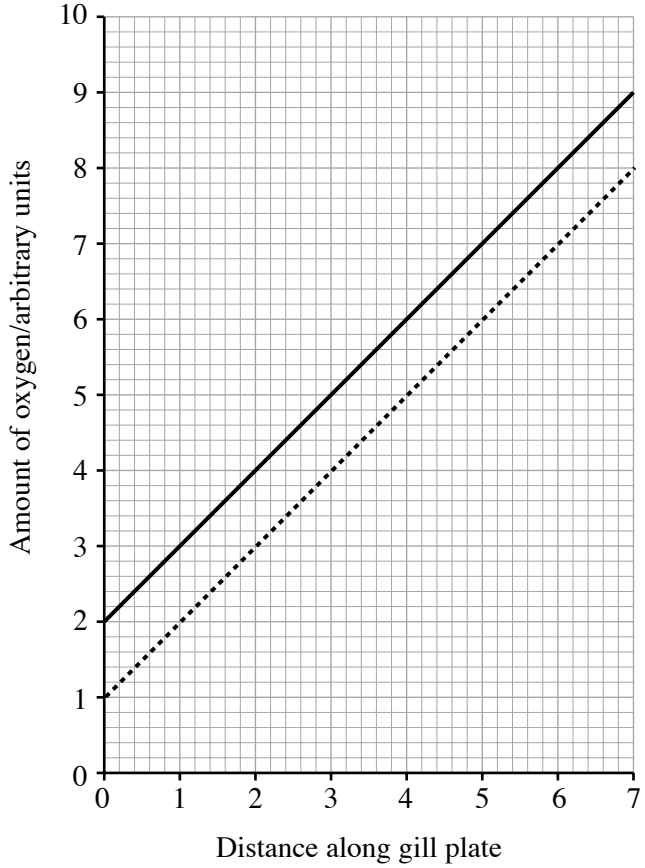
(ii) Suggest **one** medical use for a similar artificial surfactant. [1]

.....

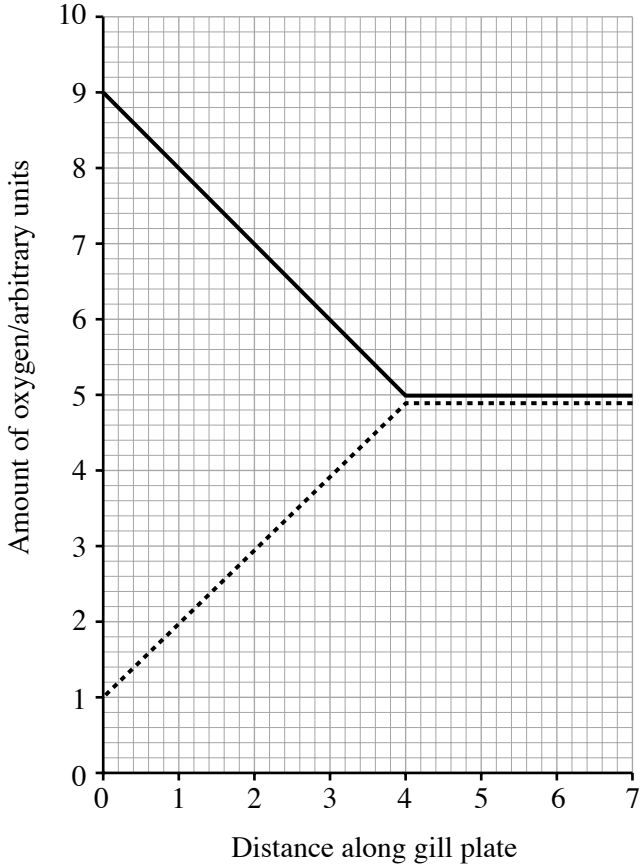
.....

(d) In some fish, water is forced over the gills in the opposite direction to the flow of blood in the gill plates (counter current flow). In others, water and blood flow in the same direction (parallel flow). The graphs below show the relative amounts of oxygen in water and blood as the water moves across the gill plates, for the different types of flow.

Graph A



Graph B



Key:

——— = ...

- - - - - - = ...

(i) Complete the key above to indicate which line shows blood and which shows water. [1]

(ii) Which graph shows counter current flow? [1]

.....

(iii) Use the graphs to put values (in arbitrary units) into the following table: [3]

	Graph **A**	*Graph* **B**
Maximum difference in amount of oxygen, between blood and water.		
The distance along the gill plate over which exchange is possible.		
The maximum amount of oxygen in the blood.		

(e) (i) Use the information in the table to state which type of flow is the more efficient. [1]

.....

(ii) Give **one** reason for your choice. [1]

.....

.....

(Total 14 marks)

4. *(a)* (i) Define the term *population*. [1]

.....

(ii) In a stable population,

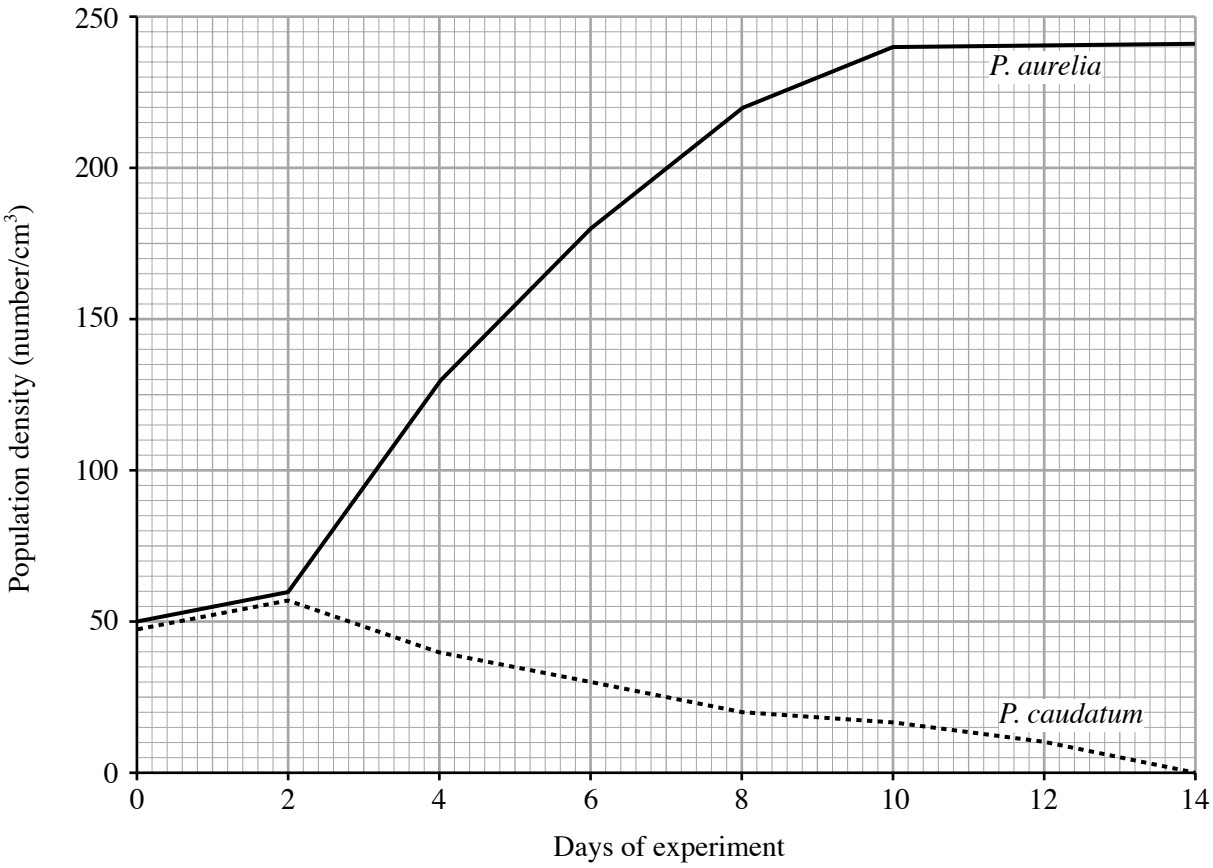
(birth rate + immigration) = (death rate + emigration)

Using the terms given in the equation, give **two** different ways by which a population might increase. [1]

.....

.....

(b) Two species of a single celled organism called *Paramecium, P. aurelia* and *P. caudatum*, were grown together in a single culture of the bacterium *Bacillus pyocyaneus,* on which they both feed. Their population densities were measured every two days and the results are given below.



(i) Over which days of the experiment were birth rate and death rate equal for *P. aurelia*? [1]

.....

(ii) Over which days of the experiment was death rate greater than birth rate for *P. caudatum*? [1]

.....

(c) The experiment shows both interspecific and intraspecific competition.

(i) Which type of competition is most likely to have caused the population of *P. aurelia* to stop increasing after day 10? [1]

.....

(ii) Which type of competition is most likely to have caused the population of *P. caudatum* to decrease after day 2? [1]

.....

(iii) What was the carrying capacity for *P. aurelia* in this experiment? [1]

.....

(iv) How might the carrying capacity have been increased in this experiment? [1]

.....

(d) (i) Distinguish between the terms *density dependent* and *density independent* factors. [2]

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.....

.....

(ii) Name a density independent factor which could have been changed in the experiment. [1]

.....

(Total 11 marks)

5. *(a)* The table below shows the results of an investigation to compare the rate of transpiration with the rate of water absorption in a leafy green plant.

Time	*Absorption* (gh^{-1})	*Transpiration* (gh^{-1})	*Light Intensity* (*% noon*)
0400	1·25	0·25	0
0800	1·25	2·0	70
1200	3·5	5·0	100
1600	5·5	7·25	100
2000	3·25	2·5	10
2400	2·0	0·75	0

(i) Name the apparatus that would have been used to measure transpiration rate. [1]

.....

(ii) What was the time of maximum absorption and transpiration? [1]

.....

(iii) What happened to the rate of transpiration after 1600 hrs? [1]

.....

(iv) What would you expect to have happened to the water content of the leaves between 2000 and 0400? [1]

.....

(v) Give a reason for your answer to part (iv). [1]

.....

.....

(b) Name the environmental factor that, these results suggest, is regulating rate of transpiration. [1]

.....

(c) Name the **cells** present in leaves which change in response to this factor and bring about changes to transpiration rate. [1]

.....

(d) Describe the role of **each** of the following in the operation of the cells named in part *(c)*.

(i) K^+ (potassium ions). [1]

.....

.....

(ii) Water potential of the cells. [1]

.....

.....

(iii) Unevenly thickened cell walls. [1]

.....

.....

(e) (i) Name the tissue through which water passes up the stem. [1]

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(ii) Name **two** forces that maintain the columns of water in this tissue. [1]

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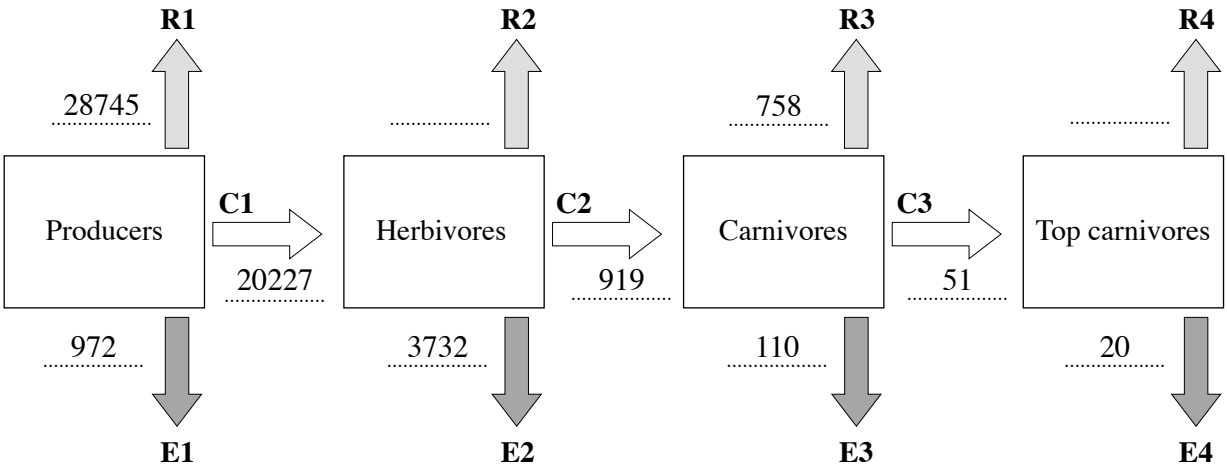
.....

(Total 12 marks)

6. The diagram shows the flow of energy through an ecosystem.



Key: **R** = Respiratory loss, **C** = Consumed, **E** = 'Expelled' (death, defaecation, excretion)

(a) The energy flow through the herbivores can be expressed by the equation:

$$C1 = C2 + R2 + E2$$

(i) Calculate the respiratory loss by the herbivores and write your answer in the correct position on the diagram. Show your workings. [2]

.....

.....

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(ii) Give the equation that expresses the energy flow through the carnivores. [1]

.....

(b) The values given are for a small wood and are in $kJm^{-2}yr^{-1}$. The area of the wood is 25 000 m^2.

(i) Calculate the total amount of energy 'expelled' by this ecosystem in one year, showing your workings. [2]

.....

.....

.....

(ii) Describe what happens to this 'expelled' energy. [2]

.....

.....

.....

(Total 7 marks)

7. Read the following passage and answer the questions.

There is little wilderness forest left on Earth. Most have been managed in some way or other at some time. Two methods that have been used since ancient times are 'coppicing' and 'slash and burn'.

Coppicing involves cutting down broad-leaved trees to ground level in winter, and thereby encouraging the regrowth of multiple stems from the stump, or 'stool'. This process is repeated throughout the woodland on a cycle of normally 7 to 25 years. One part of the wood is harvested each year, allowing for regrowth and the formation of a sustainable cycle.

Slash and burn involves felling and burning the trees to create land for agriculture. The ash from the burnt trees makes the soil fertile. On a large scale this amounts to deforestation. One current global estimate of gas emissions from biomass burning is shown in the table:

area burned	$7{\cdot}5 \times 10^5 - 8{\cdot}20 \times 10^6$ km^2
dry biomass consumed	$1{\cdot}8 \times 10^9 - 1{\cdot}0 \times 10^{10}$ metric tons
carbon dioxide (CO_2)	$7{\cdot}7 \times 10^7 - 1{\cdot}35 \times 10^{10}$ metric tons
carbon monoxide (CO)	$1{\cdot}2 \times 10^7 - 6{\cdot}8 \times 10^7$ metric tons
oxides of nitrogen (NO_X)	$2 \times 10^6 - 2{\cdot}1 \times 10^7$ metric tons
methane (CH_4)	$1{\cdot}1 \times 10^7 - 5{\cdot}3 \times 10^7$ metric tons

(a) Some of the gases in the table are known as greenhouse gases. Explain what is meant by the term *greenhouse effect*. [2]

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(b) (i) Explain why coppicing is less likely to cause soil erosion and increased sediment deposits than slash and burn. [2]

.....

.....

.....

(ii) Explain why slash and burn reduces biodiversity whereas coppicing increases it. [2]

.....

.....

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(Total 6 marks)

8. Answer **one** of the following questions.

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the structure and function of veins, arteries, arterioles and capillaries. [10]

Or *(b)* Describe the mass flow hypothesis of phloem transport. Suggest any limitations to this theory and name alternative hypotheses which have been proposed. [10]

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(Total 10 marks)